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First Impressions

The medical student’s first encounter with the intensive care unit (ICU) can be overwhelming. The life-support systems, monitors, data management tools, patient care providers, potent drugs, and complex ethical issues stirred by round-the-clock admissions and discharges easily obscure the most important element of the ICU—the patient. To the novice, the busy unit seems hectic, the humming unit seems noisy, the caring unit seems chaotic, and the professionals seem to be in constant motion around the patients. It is not surprising that many medical students find the ICU a confusing, intimidating, and challenging place.

The reality is that the ICU is a place where skilled professionals of diverse backgrounds provide highly structured, and often highly technological, care to the sickest patients in the hospital.

This introductory guide to critical care medicine is written with you, the medical student, in mind. It describes the ICU and the caregivers who staff it; the patients and how they are admitted, monitored, and treated; and some of the common medical terms and life-support equipment that are used. It includes a strategy for presenting your patient to your team and discusses some of the ethical issues that might confront you in the ICU. We want to share our excitement with you during your first encounter with the ICU in the hope that you will consider a career in critical care medicine.
ICU Types

What’s in a Name?

The hospital you are training in today is different from the hospital your attending physician claimed as his or her learning environment. Lengths of stay are down, patient acuity is rising, and critical care units are proliferating. Although the healthcare system is changing, hospitals will always need an area to care for their sickest patients—a critical care center. The need for these units is increasing as patients at all extremes of life—the most premature infants, adults with cardiovascular disease, the severely injured—are increasing, both in absolute numbers and in proportion to the general population. Citizens of developed nations around the world are living—and staying active—into the ninth and tenth decades of life. When they become ill, they often require aggressive intervention to stabilize their delicate physiologic balance so that they can heal.

While nearly all ICUs are capable of providing a spectrum of care, many have developed a focused area of excellence: care of premature or critically ill newborns in the neonatal ICU (NICU); care of critically ill and injured children in the pediatric ICU (PICU); adult cardiac diseases in the coronary care unit (CCU); perioperative care, trauma care, and care of multiple organ dysfunction in the surgical ICU (SICU); care of neurological and neurosurgical patients in the neuroscience ICU (neuro ICU). Many teaching hospitals also have graded critical care centers, such as intermediate care units and telemetry units, where patients who require more care than on a general medical or surgical floor can benefit from specific monitoring and intervention.
Each member of the ICU team has a specific role. This section of the guide reviews the roles within the team and gives you an idea of the role you, the student, can play on the team. Make no mistake—you are very much a part of this team!
**Attending.** The team leader is an attending physician. Students typically are assigned to train in intensive care units where the team leader is an intensivist physician who has received advanced training in the art and science of critical care medicine. In North America, physicians who wish to practice critical care medicine must first receive board certification in a primary specialty, either pediatrics, internal medicine, surgery, or anesthesiology. They then spend from 1 to 3 years in a critical care fellowship (depending on their specialty), after which they can take the appropriate board exam. Many countries have established critical care medicine as an independent specialty.

**Nursing Staff.** In the rapid pace of the ICU, having an integrated team of dedicated experts directed by a trained and present intensivist optimizes care for patients, improves conditions for the healthcare providers, and boosts the financial performance of the hospital. This multiprofessional team includes other healthcare professionals who work side by side, around the clock in the ICU. In the majority are the critical care nurses. Many have advanced training and certification in critical care and are recognized as CCRNs. Some nurses have pursued even more education and responsibility. They are the acute care nurse practitioners and clinical nurse specialists who complement the physician staff in establishing plans, writing orders, and directing management. Physician assistants also provide care in the ICU.

**Respiratory Therapists.** Respiratory therapists (RTs) are experts in many forms of pulmonary diagnosis and intervention. In addition to managing the mechanical ventilators, RTs often obtain and analyze arterial blood for blood gases and test patients’ breathing strength by obtaining forced vital capacity, negative inspiratory pressure, and other parameters. In some hospitals, respiratory therapists perform endotracheal intubation in addition to supporting ventilation with an ambu bag during an emergency.

**Pharmacists.** The ICU team typically includes a pharmacist who helps the team review medication profiles and determines if a patient is predisposed to side effects or drug interactions. The pharmacist will also help calculate clearance rates from measured drug levels and plan dosing schedules for many of the medications used in the ICU.

**Dietitians.** The team also typically includes an expert in nutrition, such as a dietitian who has advanced training in enteral and parenteral nutritional support strategies and pitfalls.

Other important members of the ICU team are the medical social worker, who provides ongoing psychosocial assessments and support; representatives of the chaplaincy staff, who are available on call to offer spiritual support to patients, families, and ICU staff members; and a unit secretary, who manages administrative tasks such as reception, telecommunications, and chart maintenance. In addition, the ICU staff typically includes many other trainees who are there to learn with you, such as fellows, residents, nursing students, and dietetic students.
Patients are admitted to the intensive care unit either because they require high-intensity monitoring and life support by specially trained healthcare providers or because they require high-intensity nursing care that cannot be provided on a general medical or surgical floor.

Patients come to the ICU from several areas of the hospital:

**Operating room (OR) or postanesthesia care unit (PACU).** Surgical patients who require invasive monitoring, mechanical ventilation, or resuscitation after surgery may be transported directly to the ICU from the OR or the PACU after a period of observation. Such direct transport is considered a transfer from one critical care area to another. Therefore, those patients’ ICU management is a continuation of care that they received from the anesthesiology team in the operating room or PACU.

**Emergency Department (ED).** Medical, surgical, trauma, or burn patients can be admitted to the ICU from the emergency department. These patients typically undergo a series of diagnostic tests prior to their transfer, and the etiology of their illness may or may not be known by the time they come to the ICU. They are admitted to the ICU to manage their acute illness.
Medical or surgical floor. Patients may be admitted to the ICU from a general medical or surgical floor. These are patients who were initially stable but developed respiratory distress, low blood pressure, shock, cardiopulmonary arrest, or other physiologic instabilities while on the floor. They require aggressive resuscitation, treatment, or monitoring and are transferred to the ICU for closer observation, more frequent measurement of vital signs, invasive monitoring, and/or mechanical ventilation.

Other facilities. Patients may also be transferred from another hospital or healthcare facility that does not have the resources to provide the level or type of care they require.

Common Reasons for Admission to the ICU

Respiratory compromise. Patients with respiratory distress, manifested as an inability either to oxygenate or to ventilate, are transferred to the ICU for high concentrations of supplemental oxygen and mechanical ventilation. Etiologies of respiratory distress are numerous and depend on the patient population. For example, the NICU may admit a patient with respiratory distress due to premature lungs, whereas an adult ICU may admit a patient with acute respiratory distress syndrome (ARDS).

Hemodynamic compromise. Patients with hemodynamic instability are admitted for monitoring and treatment of arrhythmias, hypotension, or hypertension. Again, the etiology of the hemodynamic problems often depends on the patient population.

Myocardial ischemia or infarction. Patients with inadequate oxygen delivery to their hearts are admitted for the management of angina and myocardial infarction. The goals of admission to an ICU are to reverse ischemia and minimize myocardial injury through the use of certain medications and/or cardiac catheterization. The ICU can provide close monitoring and rapid intervention if necessary.

Neurologic compromise. Patients with alterations in mental status are admitted to the ICU for frequent neurologic checks and to prevent the sequelae of diminished neurologic status. If their condition deteriorates, they may need to have an endotracheal tube placed to protect their airway.

Gastrointestinal bleeding. Patients with life-threatening gastrointestinal bleeding are admitted to treat hypotension with intravenous (IV) fluids and blood products and to perform diagnostic and therapeutic interventions such as endoscopy.

Renal and metabolic compromise. Patients may be admitted for treatment of the complications of renal failure, including acidosis, volume overload, and electrolyte abnormalities such as hyperkalemia or hypercalcemia. Treatment with careful attention to acid-base balance, electrolytes, and volume status is provided in the ICU.

Postoperative issues. There are many reasons for admitting patients to the ICU after surgery. Patients may need mechanical ventilation or invasive monitoring. Each surgical intervention has specific perioperative issues that may require observation and treatment in the ICU. Patients who have suffered trauma, orthopedic injuries, or extensive thermal injuries are also often admitted to the ICU.
To understand what goes on in an ICU, it is important to be familiar with some of the terminology used when dealing with critically ill patients. The following section provides definitions of some commonly used terms.

**Acute Respiratory Distress Syndrome** – an acute process of noncardiogenic pulmonary edema leading to dyspnea and hypoxemia, most often following sepsis, aspiration, pneumonia, or trauma

**Shock** – syndrome resulting in inadequate tissue perfusion and cellular oxygenation affecting multiple organ systems; the causes of this poor delivery of oxygen and nutrients can be divided into 5 main categories:

- **Cardiogenic** – inability of the heart to produce an adequate cardiac output secondary to myocardial dysfunction
- **Distributive** – maldistribution of blood flow; examples include septic shock, anaphylaxis, and neurogenic
- **Hypovolemic** – diminished blood volume, may be fluid or blood
- **Obstructive** – decreased cardiac output secondary to an obstruction outside the heart; examples include critical aortic stenosis and pulmonary embolism
- **Endocrine** – rare; occurs primarily because of thyroid dysfunction (usually hypothyroidism); in catecholamine resistant critically ill patients and in some pediatric patients, adrenal insufficiency may also cause shock

**Inotropes** – drugs that improve myocardial contractility

**Vaspressors** – drugs that increase vascular tone

**SIRS** – systemic inflammatory response syndrome; syndrome characterized by 2 or more of the following conditions: (1) hypo- or hyperthermia, (2) tachycardia, (3) tachypnea, or (4) abnormal WBC count

**Sepsis** – a documented or suspected infection with one or more additional criteria

**Severe Sepsis** – sepsis associated with organ dysfunction, hypoperfusion or hypotension

**Septic Shock** – acute circulatory failure in an infected patient unexplained by other causes or persistent arterial hypotension

**Acute Renal Failure** – sudden and often reversible deterioration in the ability of the kidneys to maintain homeostasis of the body’s fluids and electrolytes; characterized by azotemia, hyperkalemia, metabolic acidosis, hyperphosphatemia and hypocalcemia; urine output may or may not be impaired
**Fulminant Liver Failure** – syndrome of acute liver failure complicated by hepatic encephalopathy and coagulopathy that develop within 8 weeks of the onset of symptoms

**Disseminated Intravascular Coagulation** – or DIC, is a syndrome characterized by an imbalance between coagulation and fibrinolysis that causes microthrombi in the microcirculation and organ dysfunction; it can be seen in a variety of conditions, including sepsis, malignancy, liver disease, etc.

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**The Equipment**

The vast array of technology available in an ICU can be overwhelming. Even the beds have become incredibly complex, costing tens of thousands of dollars and requiring detailed operating instructions. It is stressful enough just to be in the room of a patient who is critically ill, let alone cope with the anxiety that the equipment might alarm or malfunction and require an intervention. In reality, the machines in the ICU have many fail-safe backup systems so that mechanical failure is rare. Furthermore, devices that require more supervision are usually accompanied by an individual with expertise, such as a cardiac technician for an intra-aortic balloon pump or a hemodialysis technician for a hemodialysis machine. Respiratory therapists are in close proximity to patients’ rooms and intervene quickly if a mechanical ventilator alarms or malfunctions. The best way to resolve anxiety is to become familiar with all of the different devices. The following equipment is routinely found in an ICU.

**Arterial line.** This catheter is used for (1) continuously following blood pressures or (2) obtaining frequent arterial blood gasses or other labs. It is typically placed in the radial artery, though other arteries, such as the femoral or brachial (or umbilical in the NICU), may also be cannulated.

**Bedside monitor.** All patients are connected to a bedside monitor whose screen displays several parameters, including electrocardiogram (ECG), blood pressures, and oxygen saturations, as well as lesser-used parameters, such as central venous pressures and intracranial pressures.

**Central venous line (CVL).** This catheter is placed in a central vein (for example, femoral, subclavian, umbilical, or jugulars) and used for (1) stable, long-term access, (2) administration of hypertonic solutions, (3) administration of vasoactive agents, (4) rapid infusion of large volumes of fluids or blood products, (5) frequent blood sampling, or (6) central venous pressure monitoring. Central venous pressure (CVP) is a measurement of the pressure in the right side of the heart and can be used to estimate a patient’s volume status or preload.

**Mechanical ventilator.** Patients are intubated and placed on mechanical ventilation for several reasons, including (1) to protect the airway (in patients who are obtunded and are at risk for aspiration), (2) to provide better gas exchange in patients with lung disease, (3) to lower a patient’s metabolic rate when in shock, or (4) to facilitate procedures. A patient remains on the ventilator until the underlying disease is resolved. Then the doctors and respiratory therapists begin the process of decreasing (weaning) ventilator support until the endotracheal tube can be removed, a process known as extubation.
**Other common devices.** Intravenous medication pumps allow the nursing staff to titrate medications; Foley catheters and urine collection bags aid in monitoring urine output; sequential compression devices squeeze the lower extremities and reduce the incidence of deep venous thrombosis (DVT); transvenous pacemakers stimulate the patient’s heart to beat; dialysis machines remove fluid and correct electrolyte and acid-base disturbances; intra-aortic balloon pumps assist the heart’s contractility; and intracranial monitors and external ventricular drains measure intracranial pressure (ICP) or remove cerebrospinal fluid if needed.

**Pulmonary artery catheter (PAC).** This balloon-tipped catheter is typically inserted through the internal jugular vein and then directed by the blood flow through the right side of the heart into the pulmonary artery. It allows direct measurement of several major determinants of cardiac performance, including left ventricular preload (or wedge pressure), pulmonary and systemic resistance, and cardiac output. The use of PACs is controversial, but if the information gained is used correctly, may be helpful.

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**Rounds and Presentations**

As an experienced medical student, you have already developed substantial skills for rounds. However, rounds in the ICU differ from rounds on the floor in several important respects. First, substantially more information is exchanged; that information is essential. Second, the focus in the ICU is on physiologic systems, whereas on the floor the focus is on specific problems. Third, the care in the ICU is goal-oriented. When the goals have been met, the patient is well enough to be transferred to a less-intense level of care.

In addition to providing educational value, rounds in the ICU serve 2 purposes: (1) to communicate the patient’s present status to the entire team and (2) to establish goals and plans for each patient. To accomplish those purposes efficiently and thus have time for lectures, tutorials, and hands-on skill development, students must be familiar with—and use—the ICU’s method of communication and goal setting.
Every ICU has its own unique communication and goal-setting methods, but the core of those methods is universal.

- Communication is system-based. To ensure that each patient undergoes a comprehensive evaluation each day, intensivists think—and communicate—in terms of systems. These typically include neurological (including pain and sedation management); pulmonary; cardiovascular; renal, fluid, and electrolytes; gastrointestinal (GI), nutrition, and metabolic; hematologic and infection issues; and immunosuppression. Your team anticipates a system-based presentation and expects to hear about each system in the same order for every patient. Do not try to make up your own method or revise the order. Rather, adopt and adapt the method used in your ICU. Rounds will move along more efficiently because every member of the team will know what to listen for in your presentation.

- During rounds, organ systems can be analyzed according to outcome and process variables. Outcome variables are the final physiological manifestations exhibited by the patient after certain interventions, or process variables, have been performed. For example, in the renal system, the urine output, net intake/output balance, and serum electrolytes over a 24-hour period are the outcome variables. The process variables include the rate and composition of IV fluids, the amount of supplemental electrolytes administered, and whether diuretics were used. Though systems overlap in both outcome and process variables (for example, cardiac function, pulmonary status, and fluid and electrolyte balance may all be influenced by the administration of a diuretic), the most relevant variables are reported for each system. By presenting the outcome and process variables, the intensivist sets the stage for the other important component of rounds—establishing physiologic goals. Table 1 shows outcome and process variables pertinent to particular systems.
<table>
<thead>
<tr>
<th>System</th>
<th>Outcome Variables</th>
<th>Process Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurologic</td>
<td>• Functional examination</td>
<td>• Type/route of analgesic</td>
</tr>
<tr>
<td></td>
<td>• Pain level</td>
<td>• Type/route of sedative antiseizure medications</td>
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<tr>
<td></td>
<td>• Sedation level</td>
<td>• Intracranial pressure monitors</td>
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<tr>
<td></td>
<td>• Glasgow coma score</td>
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<tr>
<td></td>
<td>• Intracranial pressure</td>
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<td></td>
<td>• Occurrence of seizures</td>
<td></td>
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<tr>
<td>Pulmonary</td>
<td>• Presence of rales or wheezes</td>
<td>• Ventilator settings</td>
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<tr>
<td></td>
<td>• Appearance of chest x-ray</td>
<td>• Administration of nebulized bronchodilators</td>
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<tr>
<td></td>
<td>• Oxygen saturation</td>
<td>• Administration of supplemental gases such as nitric oxide</td>
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<td></td>
<td>• End-tidal CO₂ concentration</td>
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<td></td>
<td>• Arterial blood gas data</td>
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<tr>
<td></td>
<td>• Spontaneous ventilation rate</td>
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<tr>
<td></td>
<td>• Forced vital capacity</td>
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<tr>
<td></td>
<td>• Negative inspiratory pressure</td>
<td></td>
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<tr>
<td>Cardiovascular</td>
<td>• Blood pressure</td>
<td>• Estimates of and interventions to adjust preload, such as CVP or pulmonary artery occlusion pressure</td>
</tr>
<tr>
<td></td>
<td>• Heart rate</td>
<td>• Estimates of and interventions to adjust afterload, such as vasodilator therapy</td>
</tr>
<tr>
<td></td>
<td>• Abnormal rhythm</td>
<td>• Estimates of and interventions to adjust contractility, such as inotropic therapy</td>
</tr>
<tr>
<td></td>
<td>• Presence of rales</td>
<td>• Estimates of (e.g., drug level) and interventions to adjust antiarrhythmic</td>
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<tr>
<td></td>
<td>• Peripheral pulses and extremity warmth</td>
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<td></td>
<td>• Cardiac output</td>
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<td></td>
<td>• Evidence of ischemia</td>
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</tbody>
</table>
| Renal/Fluid/Electrolytes | • Weight  
• Net intake and output balance  
• Current electrolytes  
• BUN, creatinine | • Intravenous fluid composition and rate  
• Supplemental electrolytes  
• Sites of unusual loss of volume  
• Sites of unexpected loss of specific electrolytes |
|-------------------------|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| GI/Metabolic/Nutrition  | • Bowel sounds, function  
• Absorption of enteral feedings  
• Fraction of caloric goal attained  
• Nitrogen balance  
• Metabolic data  
• Hyper- or hypoglycemia | • Route/rate/composition of nutritional support  
• Use of prokinetic or antiemetic agents  
• Prophylaxis against GI bleeding  
• Insulin requirements  
• Hormone replacement therapy (such as thyroid) |
| Hematologic/Infectious Disease | • New findings on physical exam suggestive of bleeding  
• Hematocrit, platelet count, and coagulation parameters  
• Temperature; findings suggestive of infection on physical exam; gram stain and culture data, including antimicrobial and sensitivity  
• Leukocyte count and differential | • Transfusion requirements  
• DVT prophylaxis  
• Procedures to diagnose and/or control infection  
• Antimicrobial prescription, including drug levels where appropriate |
Case Presentation Morning #1:

“Mr. X is a 72-year-old-male with a past medical history of type 2 diabetes, hypertension, and hyperlipidemia who presented to the emergency room last night at 10 PM with severe respiratory distress. He stated that he developed fevers, chills, and a productive cough over the past week, but had worsened significantly over the last 48 hours to the point where he ‘could not catch his breath any further.’ His wife was very concerned and finally called 911. The ER staff intubated him 30 minutes after arrival for progressive altered mental status and persistent saturations below 90% despite a 100% non-rebreather mask. An ABG was not performed prior to intubation. Post-intubation chest x-ray (CXR) revealed multi-lobar infiltrates predominant in the RLL, RML and Lingula with the endotracheal tube (ETT) 3cm above the carina. In the ER he was given ceftriaxone and azithromycin.

He was placed on ventilator settings of A/C 12, tidal volume (TV) of 600, and FiO\textsubscript{2} of 100%. The MICU team evaluated and accepted the patient for transfer to the MICU. Upon arrival to the MICU (around midnight), the team placed a triple lumen catheter in the right internal jugular vein and a right radial arterial line.

Physical exam, at that time, was significant for a low BP = 80/50, HR = 120’s, RR = 20 and a T\textsubscript{max} of 39.2. His ideal body weight is 70 kg. He had bilateral rhonchi anteriorly and bronchial breath sounds at the bases posteriorly. His heart exam was tachycardiac and regular. I did not appreciate any murmurs. There was no evidence of JVD or lymphadenopathy. Abdomen and peripheral exam were negative. Neurologically, he was not arousable on a propofol drip.

Pertinent laboratory tests included an ABG on 100% FiO\textsubscript{2}, which was 7.33/35/90 with a lactate of 4.2. His WBC = 18,000, with a normal hemoglobin and platelet count. His electrolytes were normal except for a creatinine of 2.0, glucose = 210 and HCO\textsubscript{3} = 19. His DIC profile was negative and his liver function tests were normal. Blood, urine, and sputum cultures are pending.

Repeat CXR revealed diffuse bilateral, patchy infiltrates with triple lumen catheter, and endotracheal tube both in correct position.

Mr. X was admitted with a diagnosis of community-acquired pneumonia and severe sepsis that was manifest as ARDS, acute renal failure, and hypotension. Over the night we did several things. For his ARDS, we increased his PEEP to 10 and lowered his FiO\textsubscript{2} to 70%. We repeated an ABG: 7.32/33/65. Considering his hypotension and poor urine output (only 50 cc over the previous 4 hours), we provided 3.5 L of normal saline with improvement in the BP to 110/70 and an increase in urine output to around 30 cc/hr. A repeat lactate decreased to 2.0. We changed his propofol to a fentanyl drip with maintenance of adequate sedation and improvement in the BP. We continued his antibiotic regimen. We also initiated an insulin sliding scale for his hyperglycemia. Finally, we contacted and spoke to the family at length and described the situation. His wife is the healthcare proxy.

This morning he remains hemodynamically stable with a BP = 120/70, HR = 92, remains febrile at 38.3, and a SaO\textsubscript{2} = 93% on 70% FiO\textsubscript{2}. His I/O’s are now 4.2 L in and 600 mL out over the last 12 hours, and he remains on IV fluids. His ventilator settings are A/C 12/600/70/10 with peak airway pressures around 24. His physical exam has not changed significantly. Pertinent labs include his WBC which remains around
20,000, though his creatinine has decreased to 1.8, and his lactate has decreased to 2.5, as stated previously. His glucose is now 270 despite a subcutaneous regular insulin sliding scale.”

**Period of team discussion, and teaching and/or questions by the attending physician.**

“To summarize, this is a 72-year-old-male with severe community-acquired pneumonia and severe sepsis complicated by ARDS, acute renal failure, hypotension that responded to fluid resuscitation, and hyperglycemia. In order of systems, neurologically he is on a fentanyl drip for sedation and we added Ativan 2 mg every 6 hours for agitation. Pulmonary: as we discussed on rounds, Mr. X meets the criteria for ARDS and we will change his ventilator settings according to our ICU ARDS ventilator protocol with focus on a low tidal volume strategy. We will monitor his FiO\textsubscript{2} requirements and consider a pulmonary artery catheter. Cardiovascular: we will continue to fluid resuscitate him with normal saline at 150 cc/hr and monitor his blood pressure, urine output, and lactate levels. Renal: we are encouraged by his increasing urine output and decline in creatinine. Infectious disease: we will follow up his blood, urine, and sputum cultures and continue the ceftriaxone and azithromycin. Considering he has severe sepsis and developed multiple organ dysfunction syndrome and has a low bleeding risk, we will start activated protein C for a 4-day IV drip and monitor his coagulation and for bleeding. Endocrine: we are concerned about his significantly elevated glucoses and therefore will start an insulin drip at 5 units/hour and will titrate for a target glucose of 80-110. After placement of an NGT, we will initiate enteral feeds at 10 cc/hr. We will give Pepcid for stress ulcer prophylaxis and 5,000 units SQ heparin for DVT prophylaxis. Finally, we will continue to have discussions with and update the wife regarding his care and progress.”

**Case Presentation Morning #2:**

“Everybody remembers, Mr. X, our 72-year-old-male who presented to the ER 2 nights ago with respiratory distress and hypotension secondary to a severe community-acquired pneumonia and severe sepsis and was subsequently intubated and transferred to the MICU where he developed ARDS and acute renal failure.

Events of the last 24 hours included the development of atrial fibrillation with a rapid ventricular response around 140 beats per minute. Since he was hemodynamically stable with a BP=120/70, we pushed 20 mg of IV cardizem and his rate dropped to 84, but remained irregular. We started a Cardizem drip at 5mg/hour.

He remains intubated and sedated. His vital signs are BP = 120/70, HR = 84 and irregular, RR = 20, Tmax = 38.0, and SaO\textsubscript{2} = 97% on ventilator setting of A/C 20/420/40/10. His peak airway pressures remain around 20-25. Bronchial breath sounds persist at the bases. This morning’s ABG was 7.35/45/110 on 40% FiO\textsubscript{2}. CXR still demonstrates bilateral diffuse infiltrates with correct positioning of the endotracheal tube, nasogastric tube, and right internal jugular triple lumen catheter. The RIJ TLC and right radial arterial line sites are clear and both day #2 in place. Heart rate remains irregular. He has no JVD. He has developed new 1+ peripheral edema. Over the last 24 hours his ins and outs were 5.5 L and 2.4 L. His creatinine is normalizing to 1.4 and his HCO\textsubscript{3} has increased to 24. His lactate is now normal at 1.0. He is receiving finger sticks every 2 hours while on the insulin drip and his last two glucoses were 115 and 98 on 3 units per hour. Abdomen exam is benign and he has bowel sounds. His WBC has declined to 12,000. His platelet count remains around 300 and his INR=1.1.”
Period of team discussion, and teaching and/or questions by the attending physician.

“Mr. X remains intubated in the ICU with severe community-acquired pneumonia and ARDS. We are encouraged by his lower FiO$_2$ requirements and improved renal function. Neurologically, we will begin to reduce his sedation and attempt to wake him up over the next 24 hours. Pulmonary: we will continue the protective ventilatory strategy and begin to reduce the PEEP as tolerated. Cardiovascular: he remains hemodynamically stable and we will titrate him off the cardizem drip for his atrial fibrillation and change him over to p.o. cardizem. Renal: we will hold his IV fluids today and continue to monitor his urine output and creatinine. Infectious disease: he is responding to the antibiotics demonstrated by a reduction in his WBC and fever curve. His cultures still remain negative, we will continue ceftriaxone and azithromycin day #2 out of 10 day total course. He is tolerating the activated protein C drip day #2 well with no evidence of coagulopathy or bleeding. Endocrine: we will continue the insulin drip at 3 units/hour. He is tolerating his enteral feeds so we will advance them to our nutritional goal. We will continue to update Mrs. X regarding his care and progress.”

Ethical Issues in the ICU

Ethical issues in the ICU often entail decisions to implement do-not-resuscitate (DNR) orders or to withdraw life support. In fact, the results of one online survey suggested that 90% of adult patients who die in an ICU do so after making the decision to limit therapy. Such issues provoke strong emotions in the best of circumstances. To unravel the religious, social, and personal aspects of an individual case it is important to follow some concrete guidelines.
First, determine the patient’s goals of therapy. The clinician must be able to describe the patient’s illness, prognosis, treatment options, and risks and benefits of treatment. Patients and families cannot outline treatment plans without that information.

Second, compare the patient’s goals with what can be medically achieved. For example, a patient with leukemia has completed a course of chemotherapy. He has stated that if his heart stops, he does not want chest compressions during hospitalization. A DNR order is entered in the chart. During the hospitalization the patient develops severe pneumonia, requiring admission to the ICU. The goal of therapy is to treat the pneumonia and support the patient until he can recover. To that end, the patient should be supported with antibiotics and mechanical ventilation if needed. This is not inconsistent with the DNR order. On the other hand, had the patient failed all chemotherapy and reached the end of life, with no hope for survival, admission to the ICU would not be appropriate. In such instances, patients frequently request that the goal of therapy be directed toward comfort and that they not be resuscitated when their cardiac or respiratory system fails. Decisions to admit patients and treat them aggressively with invasive equipment are based on an understanding of the underlying illness and the patient’s therapy goals.

Third, do not be confused by the concept of medical futility. In actuality, very few treatments are truly medically futile. Most treatments work; however, one must consider if the resulting quality of life has value to the patient. Again, the clinician and patient must have established a goal. Consider a patient with severe end-stage heart failure and respiratory distress due to pulmonary edema. If the goal is to return home to a normal life, all treatment is futile, and the patient may elect for comfort care when he or she develops respiratory failure. If the goal is to return home with limited function and be with family for as long as possible, admission to the ICU for support with diuretics and inotropes may be appropriate. The doctrine of double effect may be useful when considering these issues. This ethical concept contends that an action (such as a medical therapy) should be performed, despite the known possibility of a bad side effect, if the good of the action outweighs the bad.

Fourth, when patients are unable to make decisions, who speaks for them? Someone has to outline a patient’s goal of therapy. Traditionally it is the family members in order of legal recognition—the spouse, the children, and then the siblings. If a family member has had a specific conversation concerning treatment goals, the resulting information is called substituted judgment. If they have not had such a conversation, families may make decisions using a best interest model. To minimize the distress to families, Congress passed an act that lets patients decide for themselves and express their preferences by completing advance directives. There are several kinds of advance directives, including living wills and durable powers of attorney. A living will is a written document in which a competent patient specifies his or her preferences for future treatment. Unfortunately, the difficulty of predicting all future circumstances may lead to ambiguities that limit the usefulness of a living will. A durable power of attorney is a written legal document in which a competent patient designates another individual to speak for him or her and to make decisions about healthcare. Information from a family member who has discussed healthcare wishes with the patient and can make decisions using substituted judgment is also a valid form of advance directive.

When it is clear that the goals of therapy are unachievable, therapy can be discontinued. However, be very careful. To know that treatment is futile, the clinician must know what the problem is. For example, when an emergency response team discovers an unresponsive patient with widely metastatic breast carcinoma, there may be a debate concerning treatment.
Option A: If the patient has an unambiguous advance directive saying that she wants comfort care only, no intervention should be provided.

Option B: If the care directives are unclear, the patient should be supported until the etiology of unresponsiveness is discovered.

One outcome may be that the patient will be found to have inoperable metastasis to the brain. Therapy can be withdrawn when futility of care is determined. However, the patient could also have decreased mental status secondary to inadvertent overadministration of narcotics or secondary to hypercalcemia, both medically reversible.

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**Why Is Critical Care Medicine So Satisfying?**

The issues that may overwhelm the student are the very ones that make critical care an immensely satisfying career choice. The effective critical care medicine (CCM) attending is like an orchestra conductor, directing various staff to integrate their diverse talents toward 1 goal. It is very gratifying to resuscitate an unstable patient, initiate appropriate therapy, evaluate outcome, and ultimately discharge the patient to a nonacute area. However, not all interventions and resuscitations are successful. The ICU is often an environment where patients die. Although death may not be a satisfactory outcome, it is reality. The CCM attending uses personnel, monitors, and equipment to support patients during treatment in hopes of achieving the goals of therapy. When it is clear that those resources are prolonging life without achieving the patient’s goals, the therapy is futile and the patient should be allowed to die. There is an art to bringing a family through this decision-making process. A skilled CCM attending will ensure that the family has been informed, has not been overwhelmed by issues they do not understand, and has come to the realization that the patient’s goals are not achievable. Providing comfort then becomes the primary objective.

The process for both successful and unsuccessful outcomes is unique to the ICU. Nowhere else do so many individuals—physicians, special consultants, nurses, respiratory therapists, technicians, pharmacists—pool their cognitive and technical skills. It is an environment rich in continued educational opportunity, with the CCM attending directing it all. Unlike some specialists, the CCM attending is a generalist in a specialized environment. The CCM attending must be an expert in cardiology, pulmonary, renal, neurology, and infectious disease, and must be able to integrate those disciplines into the care of a patient with multiple organ failure. In addition, the CCM attending must be able to communicate with specialists in those areas.

The specialized equipment in the ICU also provides a unique opportunity to observe physiology in real time. Nowhere else can the attending evaluate hypotension, measure inadequate filling of the left ventricle, administer a bolus of fluid, repeat the cardiac output, and measure the effect of increased output on organ perfusion. No other environment provides an opportunity to demonstrate the effect of ventilator support or changed ventilator parameters on reducing the work of breathing. Many of the interventions have immediate consequences that are predictable and measurable. The rewards of a treatment intervention are obvious to patient and clinician.

Should you decide to pursue a career in critical care medicine, as a fourth-year student you can take an elective in the ICU. You can also join the Society of Critical Care Medicine to learn about career opportunities and the people in the ICU. For a career in critical care medicine, you will have to obtain
training in a primary field of anesthesiology, internal medicine, pediatrics, or surgery. Fellowship training requirements are different for each primary specialty. For example, individuals who have trained in anesthesiology and surgery require only 1 additional year of training in critical care, whereas individuals who have trained in internal medicine require at least 2 years of critical care training. In pediatrics, 3 years of fellowship training are required. During your fellowship training you will have an opportunity to decide whether you wish to practice in a community setting or in an academic institution such as a university.

We at the Society of Critical Care Medicine hope that this brief introduction has piqued your interest in critical care and alerted you to the exciting career opportunities in this arena. For information regarding membership, please contact customer service at 847-827-6888 or www.sccm.org.